Space Weather Technical Forecast

Issued on Saturday, 17 February 2024 at 00:39 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: M-flares likely and a slight chance of X-flares. Slight chance of S1/Minor Radiation Storms. Slight chance of G1/Minor Geomagnetic Storm Day 3-4 (19-20 Feb) due to possible CME arrival.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity has been High, with an X2.5 flare peaking at 16/0653 UTC, from AR3576 which is on the southwest limb. There are now nine sunspots on the visible disc, with AR3576 no longer visible on the southwest limb. This likely remains a large, magnetically complex sunspot region, and will contribute a gradually decreasing amount to flare probabilities for the next day or two. AR3583 has developed further intermediate spots, with some minor magnetic complexity. AR3582 appears to have simplified with penumbra on trailing spots disappearing. The remaining regions currently appear mostly simple, with no significant development observed.
A couple of possible Earth-directed CMEs were observed in the past 24hrs. The first was a result of a filament liftoff in the north centre disc which may give a glancing blow on 19 Feb, and a second in association with the X2.5 flare from the southwest limb which is now considered most likely to miss.

Solar Wind / Geomagnetic Activity: Solar winds as observed by ACE and DSCOVR at L1 have been at ambient or slightly elevated levels, although a weak transient appeared to arrive after 16/0900 UTC. Wind speeds were around or just below 400 km/s. Density has been at average to below average levels. The IMF, Bt, was mostly weak, but briefly reached moderate levels around 9nT after the transient arrived. The north-south component, Bz, varied moderately but was mostly northward directed, between -3/+9nT. Phi angle was variable. Geomagnetic activity was Quiet (Kp 0 to 2).

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux has been elevated above background levels, but below the S1/Minor Storm threshold throughout. It reached a maximum of 6.6pfu at 16/1030 UTC. Electron flux (greater than 2MeV) has been at background levels, with electron fluence well below the Active (1e8 integrated pfu) threshold. The observed fluence at 17/0000UTC was 1.5e6 pfu.

Four-Day Space Weather Forecast Summary
Solar Activity: Further Moderate activity is likely, with a slight chance of X-class flaring. Activity is expected to decline through the next couple of days as AR3576 rotates well onto the far side of the Sun.

Solar Wind / Geomagnetic Activity: Two possible Earth-directed CMEs were identified in the past 24 hours. Both of these are considered more likely to miss Earth, but with the possibility of some glancing influence from one of these either late Day 3 (19 Feb) or early Day 4 (20 Feb). In the absence of any CME arrivals, solar wind speeds are expected to remain near ambient or perhaps at slightly elevated levels.
Geomagnetic activity is expected to be mostly Quiet through this period, perhaps becoming

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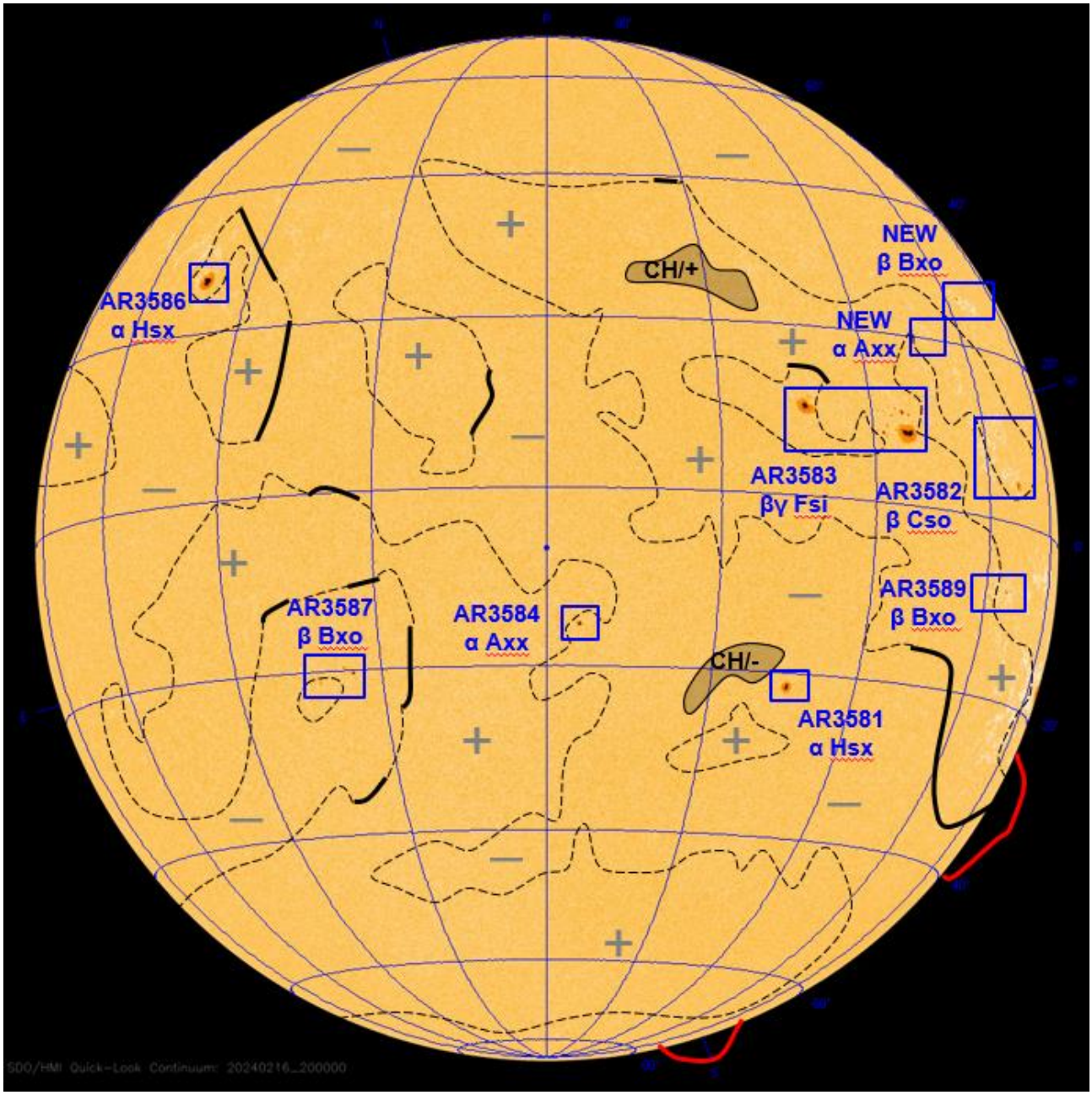
Unsettled to Active with a slight chance of an isolated G1/Minor Storm interval with any CME arrival on Days 3-4.

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux is forecast to slowly decline towards background levels in the absence of any further enhancements, although AR3576 still presents a risk of additional radiation storms. High energy electron flux (greater than 2MeV) is expected to remain at background levels. The associated 24-hour electron fluence is expected to stay below the Active threshold.

Figure 1. Solar Analysis Valid 16/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Two possible Earth-directed CMEs were identified in the past 24 hours. The first was a result of a filament liftoff from the north centre disc. The majority of the ejecta is expected to travel north, above Earth's orbit, but with the possibility of some glancing influence either late Day 3 (19 Feb) or early Day 4 (20 Feb). The second CME was in association with the X2.5 flare from AR3576 on the southwest limb. Further analysis of this CME suggests that it will pass ahead of and below Earth's orbit.

No significant coronal holes are visible on the Earth-facing disc, with just a couple of very small and weak holes seen in imagery. In the absence of any CME arrivals, solar wind speeds are expected to remain near ambient or perhaps slightly elevated levels.

Geomagnetic activity is expected to be mostly Quiet through this period, perhaps becoming Unsettled to Active with a slight chance of an isolated G1/Minor Storm interval with any CME arrival on Days 3-4.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	5	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
16/0755	Partial	Filament	North centre	770 km/s	19/2100 UTC	Glancing blow, low confidence

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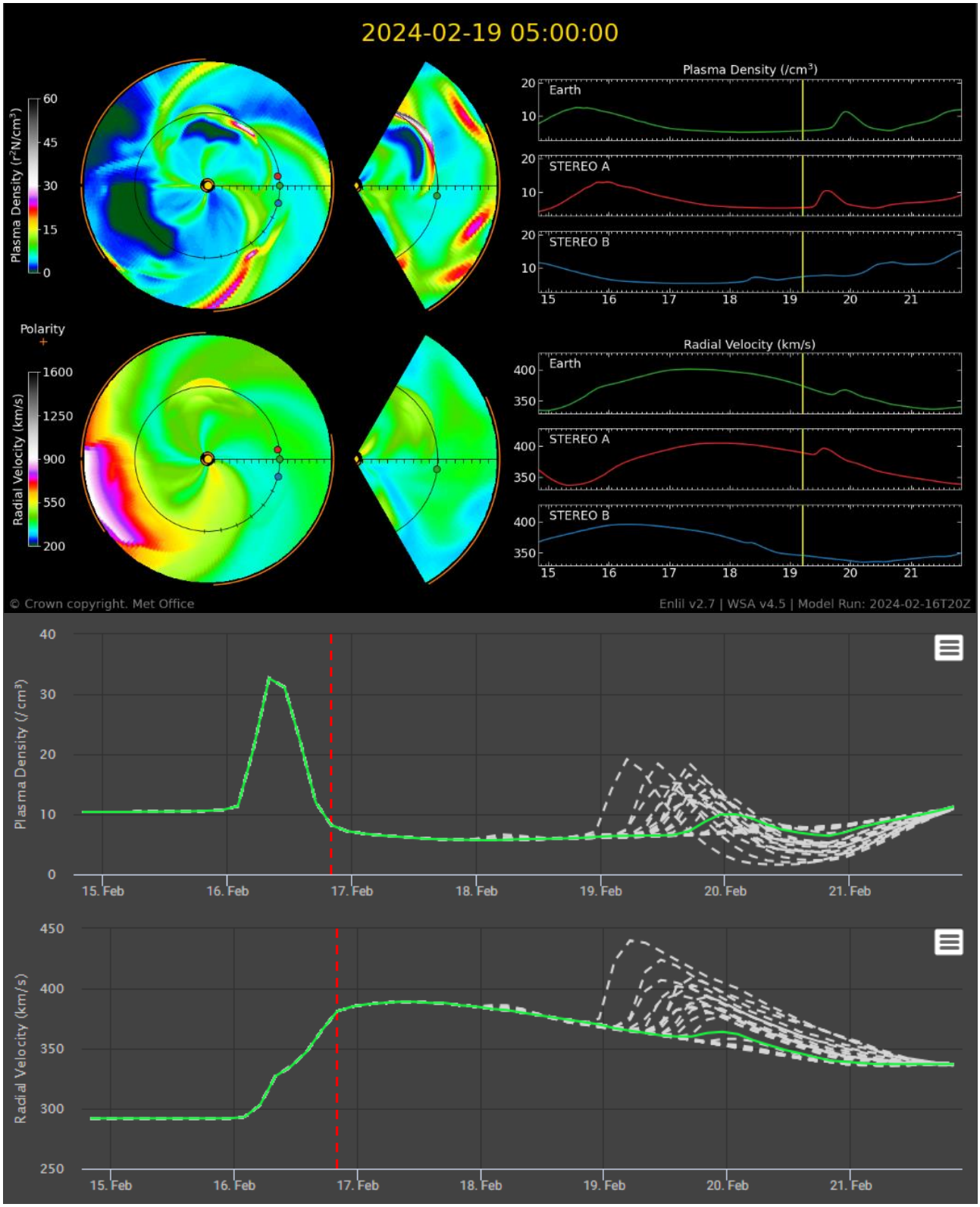
Figure 2: MOSWOC Enlil and ensemble, showing potential CME glancing blow late 19 Feb or early 20 Feb.


2024-02-19 05:00:00
Plasma Density (/cm³)
Earth
STEREO A
STEREO B
Plasma Density (r²N/cm³)
Polarity
Radial Velocity (km/s)
Radial Velocity (km/s)
15 16 17 18 19 20 21
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Enlil v2.7 | WSA v4.5 | Model Run: 2024-02-16T20Z
Plasma Density (/ cm³)
Radial Velocity (km/s)
15. Feb 16. Feb 17. Feb 18. Feb 19. Feb 20. Feb 21. Feb

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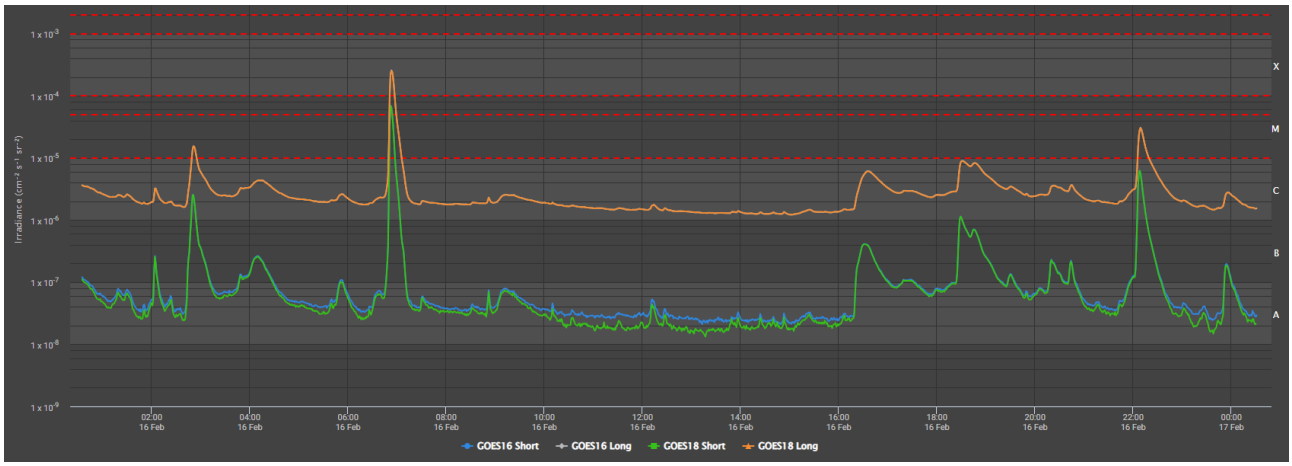
Radio Blackouts - X-Ray Flares:
Activity has been High, with an X2.5 flare peaking at 16/0653 UTC from AR3576 just on the southwestern limb.

There are now nine sunspots on the visible disc, with AR3576 now no longer visible on the southwest limb. This likely remains a large, magnetically complex sunspot region, and will contribute a decreasing amount to flare probabilities for the next day or two. AR3583 has developed further intermediate spots, with some minor magnetic complexity. AR3582 appears to have simplified with penumbra on trailing spots disappearing. The remaining regions currently appear mostly simple, with no significant development observed.

The main flare risk comes from AR3576, but this will decline as it rotates away from the limb. There is also a lower risk from AR3583, although this has shown little activity of late. M-flares are likely, with a slight chance of a further isolated X-flare, mainly from AR3576.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	60	50	40	40
Very Active	R3 to R5 X Class	Yes	20	5	5	5

Figure 3: X-ray flux at GOES16 and 18, showing an X2.5 flare from AR3576 on the southwest limb.



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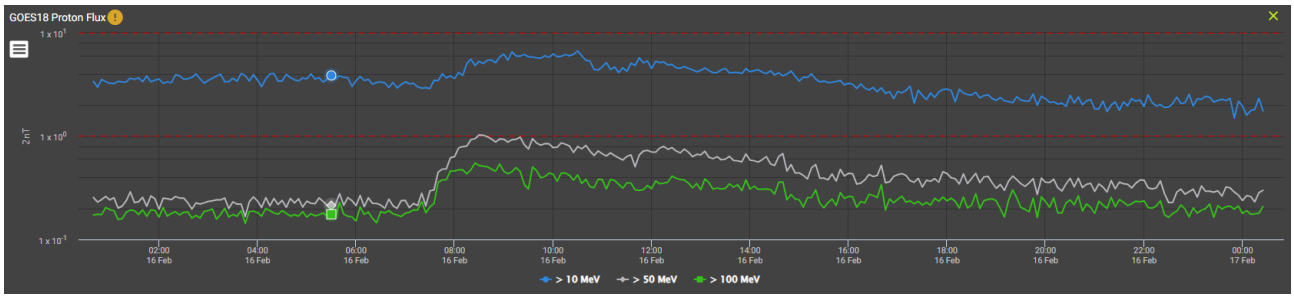
Solar Radiation Storms - (High Energy Protons):
GOES 18 high energy (greater than 10MeV) protons rose in response to the X2.5 flare that originated from AR3576. Values stayed below the S1/Minor Radiation Storm threshold, and are now declining again. They are likely to continue to decline, unless we see another large flare from the western side of the Sun.

The risk of further enhancements will mostly likely be as a result of AR3576, or perhaps AR3583, although this region is much less complex. Both these regions are in the western hemisphere, which is the main location for proton rich events to reach Earth. Despite AR3576 rotating over the west limb, the risk of proton events from this region will remain for at least 2-3 days before declining.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	15	15	15	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: Proton flux at GOES18, which showed a brief and weak response to the X2.5 flare earlier today, but is now declining.



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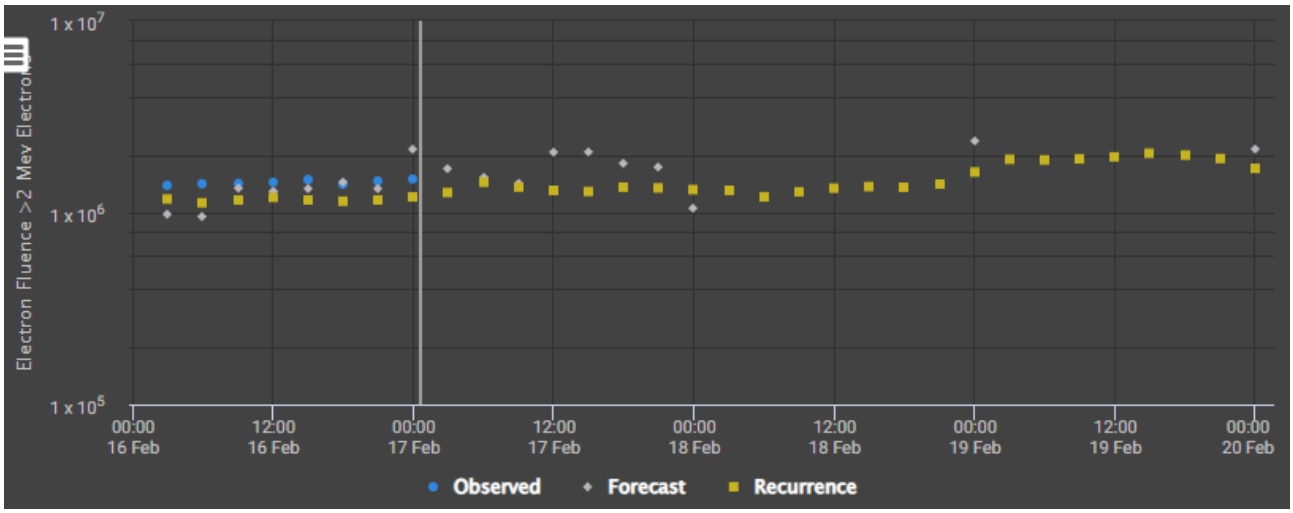
High Energy Electrons Event (≥ 2MeV):
High energy electron flux (greater than 2MeV) at GOES16 is expected to remain at background levels. There are no High Speed Streams expected, and any potential CME glancing blow on Day 3 is likely to be weak, and therefore not expected to drive a significant increase in electron flux.

24-hour fluence values are expected to continue well below the Active (1e8 integrated pfu) threshold, as suggested by REFM.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: MOSWOC REFM showing a below Active trend through the next 3 days.



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